nately, in very few cases is the number of students attending the scientific as distinct from the literary classes given, and only in one or two universities has science as yet been erected into a separate faculty. If we may take the two universities, Strassburg and Tübingen, in which natural science forms a separate faculty as a criterion from which to judge of the number of students of science in the other universities, the proportion must be very large. In Strassburg, of the 236 students whom we have placed in the philosophical faculty, ninety-seven are students of science, and in Tübingen 100, or something like one-third of the whole philosophical faculty. Or again, if the number of science students is at all in proportion to the number of science-teachers, the position held by science in German universities is in striking contrast to its position in our universities and colleges. Of the professors, among whom we do not count the privat-docenten, about one-half belong to the philosophical faculty, and of these again, nearly one-half are teachers of science, that is, in the philosophical faculty of the German universities there is one teacher on an average to every ten students, and in science the proportion is considerably greater. In these estimates we do not take account of the medical faculty, in which, in most of the universities, there are several chairs which might well be classed as belonging to science generally.

For example, the well-known anthropologist, Dr. Virchow, the conclusion of whose address at the German Association we give this week, is Professor of Pathology at Berlin, and has been able to bring the results of his special medical line of investigation to bear, in an important way, upon his anthropological researches. Both in Berlin and elsewhere, other names of eminent medical professors might be mentioned who have not only themselves made important contributions to science, but under whom students are encouraged to do so likewise.

Of the nature and extent of the scientific teaching in German universities some idea may be formed from the subjects represented by the teaching staff at Berlin, which may fairly be taken as a type of the whole. In Berlin then we find that there are (excluding the privat-docenten) five professors of mathematics, two of astronomy, seven of chemistry, five of physics, three of geology, four of botany, two of zoology, one of meteorology, two of geography, one of anthropology, and one of agriculture—physiology and comparative anatomy being well represented in the medical faculty, and we might well have included among teachers of science those who devote themselves to the scientific investigation of languages. But a mere statement of the number of teachers gives no adequate idea of the means at the command of a German University for training its students in science. The number of teachers in each subject secures that its various departments will be thoroughly worked out, and gives a student a chance of following out any specialty he may take up; this is made still further possible by the number and variety of institutions, museums, laboratories, collections, &c., attached to each university, not to speak of its large and comprehensive library. In connection with Berlin alone there are twenty-three scientific "Anstalten," as they are called, for practical investigation in connection with the various faculties. Had we taken the numerous Realschule and the high and polytechnic schools into account, where an education can be obtained quite equal to that obtainable at most of our universities and colleges, it would have been seen that higher education in Germany leaves little to be desired.

And in reference to the subject of our leader this week, we would point to these Realschulen as embodying the German idea of what *practical* training should be. The carefully drawn-up time-tables of these schools are an instructive study, showing, as they do, that general mental culture is regarded as of the first importance in training a youth for the work of the world.

The *Jahrbuch* gives a statement of income and expenditure in connection with only one or two of the universities. Some interesting details, however, on the contributions of the State to the universities, as well as on other points, were given in a recent number of the *Academy* by Prof. Ray Lankester:—

"The sum expended by the North German States on the twenty universities belonging to them is annually more than 500,000*l*. The Imperial Government has expended upon the new University of Strassburg alone 70,000*l*. in one year. The University of Leipzig alone receives annually from the Saxon Government over 50,000*l*. There are eight universities in North Germany which are little, if at all, less costly, and there are eleven of smaller size which receive each from 8,000*l*. to 20,000*l*. annually.

"In North Germany there is one university to every two million inhabitants; in Austria there is one to every five millions; in Switzerland one for each million; in England one to every seven millions. In the twenty North German universities there are 1,250 professors.[1] In the British Islands we ought to have sixteen universities and 1,000 professorships in order to come up to the same level in this respect as North Germany. The stipend (apart from fees) of a professor in a German university ranges from 100*l*. to 600*l*. a year. As a rule, at the age of five-and-thirty, a man in this career may (in Germany) count on an assured income of 400*l*. a year (with retiring pension). The expenditure on attendants, libraries, laboratories, and officials may be calculated as being (in a well-conducted university) more than equal in amount to the total of the professors' stipends. Taking the *average* German professorial stipend at only 200*l*. a year, we find that 250,000*l*. must be spent annually on this item alone in the North German States.

"In order to equip and carry on sixteen universities in this country which should bear comparison with the German universities, we require not less than an immediate expenditure of 1,000,000*l*. sterling in building and apparatus, and an annual expenditure of from 500,000*l*. to 800,000*l*."

When we add to the Government subsidy the income of the universities from other sources, the sum is enormously increased. The half-million, moreover, does not include the occasional grants of the Government for special purposes. Some idea of the magnificence of these was shown in our recent "University Intelligence," where it was stated that in the budget submitted to the present Prussian House of Deputies are the following items:—Erection of the German Industrial Museum, 998,000 mk.; erection of a Polytechnic in Berlin, 8,393,370 mk.; erection of an Ethnological Museum in Berlin, 1,800,000 mk.; and for the Berlin University, erection of an Herbarium, 422,000 mk.; of a Clinic, 1,955,000 mk.; of a new building for a second Chemical Laboratory, as well as of a Technical and Pharmaceutical Institute, 967,000 mk.

OUR ASTRONOMICAL COLUMN

THE METEORITE OF JULY 20, 1860.—The occurrence of the splendid meteor of November 23, which has probably been observed with sufficient completeness to allow of the determination of its path, while it remained visible, recalls a similar object which passed over the northern parts of the United States and adjacent parts of Canada, on the evening of July 20, 1860, which was made the subject of investigation by the late Prof. J. H. Coffin, of Lafayette College, N.Y. Probably no one of these remarkable bodies has been more extensively observed, and we do not remember any case where the calculations have been more laboriously conducted, and with greater hope of reliable results.

[1] *i.e.* we presume professors strictly so-called, exclusive of "privat docenten."

The "meteoric fire-ball," as Prof. Coffin calls it, was first seen moving in an easterly direction from a point nearly over the western shore of Lake Michigan, though it may have become luminous somewhat further to the west as the sky was clouded over that region. From thence it was watched until it disappeared out at sea in a south-easterly direction from the island of Nantucket. Its course was therefore about 1,300 miles, and it was seen for several hundred miles on either side of this track. Upwards of 230 descriptions of the meteor were collected, and upon the best of these Prof. Coffin undertook the determination of the orbit, by an elaborate process detailed in his memoir, which formed No. 221 of the "Smithsonian Contributions to Knowledge," entitled "On the Orbit and Phenomena of a Meteoric Fire-ball, seen July 20, 1860." The various accounts of the meteor are printed in the memoir, and reveal some peculiar points of interest in its path. There were two "remarkable ruptures of the main body of the meteor," particularly near the meridian of 77° west of Greenwich, when it separated into two parts nearly equal in size which disappeared below the horizon, as one observer describes it, like a chain-shot.

Considering that whatever might have been the orbit of the meteor before it became visible, its course while it was under observation, from being so near the earth, must have been controlled almost wholly by her attraction. Prof. Coffin mentions that the orbit he has investigated is not the path of the meteor in space, but the orbit relative to the earth, having the centre of our globe in one of its foci. Approximate elements having been obtained, azimuths and altitudes deduced from them were compared with those given by the various observations to ascertain what modifications of the elements were required in order to satisfy them. It was found that with certain corrections thus indicated the first orbit represented tolerably well most of the reliable observations to the west of 76° or 77°, near which the most easterly of the two points from which it was determined, was situated; but further to the east the discrepancies between calculation and observation were "so great that they could be reconciled only by introducing changes in the elements of the orbit, one on the meridian of 77° and another near the meridian of 74°, and as Prof. Coffin remarks, it is worthy of note that it was in the vicinity of these points that observers report the violent ruptures of the body of the meteor, which seems to afford a rational explanation of the changes of elements found to be required. It was apparent that while the meteor descended rapidly towards the earth till it reached the meridian of about 74°, it afterwards rose, and the change was too great to be accounted for on the supposition that the meteor at that point attained the perigee of its hyperbolic orbit. After the introduction of other considerations, it resulted that the path divided itself into three sections, "the first and third of indefinite length, over only a small portion of which the meteor was visible, and the second an intermediate one, 160 miles long, where it was most brilliant." The elements for the three sections, as finally adopted, are:—

	Sec. I.	Sec. II.	Sec. III.
	° ′	° ′	° ′
Long. of perigee	294 57 ...	275 37 ...	261 2
,, descending node...	332 56 ...	325 11 ...	329 24
Inclination to ecliptic	66 12 ...	67 10 ...	66 26
Eccentricity	2·9984 ...	2·9817 ...	2·9921
Major semi-axis	2005·3 ...	2005·3 ...	2005·3
Perigeal distance	4007 ...	3974 ...	3995

The major semi-axis and the perigeal distances are expressed in miles. According to these elements, Prof. Coffin concludes that the meteor entered the sphere of the earth's attraction from the direction of the constellation Sextans, in about R.A. 148°, N.P.D. 87°, and left it toward a point in R.A. 355°, N.P.D. 121°.

The Planet Mars and B.A.C. 8129.—The near approach of Mars to the seventh-magnitude-star, B.A.C. 8129, appears to have been observed pretty generally. Taking the mean place of the star from the Washington Catalogue of 1860, its apparent position on the evening of November 12 is found to be R.A. 23h. 14m. 24·37s., N.P.D. 96° 34′ 22″·5. By Leverrier's tables the place of Mars at 6h. Greenwich time and the hourly motions were:—

R.A. ... ... 23h. 14m. 24s·91 + 3s·473*t*.
N.P.D.... ... 96° 34′ 25″·1 − 30″·49*t*.

Taking account of parallax, the star at 6h. would be on an angle of 319°·4, distant from planet's centre, 17″·8, by calculation, as seen at Greenwich. Probably the actual approach was not quite so close.

The Binary-star Castor.—Dr. Doberck, of Col. Cooper's Observatory, Markree, whose investigations relating to the orbits of the revolving double-stars have been on several occasions referred to in this column, has corrected the elements of the fine binary α Geminorum, given by Thiele in 1859, by measures to 1877 inclusive. Thiele's period of revolution was 997 years, Dr. Doberck's calculation gives 1,001 years, and the comparison with observations, from those of Bradley and Pound in 1719 to the present year, exhibits no larger differences than are to be attributed to unavoidable errors, or in one or two cases, bias on the part of the observer. The new elements are as follow:—

Passage of the peri-astre	1749·75.
Node	27 46 (meridian of 1850).
Node to peri-astre on orbit ...	297 13
Inclination	44 33
Eccentricity	0·3292
Semi-axis major...	7″·43
Revolution	1001·21 years.

This orbit gives, for 1878·0, position 234°·9, distance 5″·76.

Transits of the Shadow of Titan across the Disc of Saturn.—Mr. Marth has drawn attention to the following dates of transit of the great satellite's shadow, as the only opportunities for observation until the year 1891:—December 9, about 6½h. Greenwich time, December 25, about 5¾h., and January 10, about 5h.

The "Nautical Almanac," 1881.—As usual the *Nautical Almanac* was published in November, the last volume being for the year 1881, which does not appear to be one distinguished by any particular astronomical phenomena. The two solar eclipses on May 27 and November 21, the first partial, the second annular, are both invisible in this country, and the line of annularity in the November eclipse runs at great south latitude. The total eclipse of the moon on June 11 will also be invisible here, while in the partial eclipse on December 3 (magnitude 0·97) the moon will rise at Greenwich about twenty minutes after first contact with the shadow. A transit of Mercury on November 7, will be wholly invisible in this country, the first external contact (geocentric) taking place at 10h. 16m. 13s., and the last at 15h. 37m. 41s. mean times at Greenwich. The list of visible occultations does not contain any planet, nor any star over the third magnitude. The list of standard stars is on the same scale as for the year 1880, and numbers close upon 200. The *Nautical Almanac* circulates to the extent of more than 20,000 copies, inclusive of the number appropriated for the use of the Royal Navy.

OLE RÖMER

When Newton's "Principia" raised the theory of astronomy to a height not previously dreamt of, practical astronomy was still where Tycho Brahe left it almost a century before. Such was the respect paid to